SPECIFICATION

TITLE

"MAGNETIC RESONANCE APPARATUS WITH SOUND INSULATION"

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a magnetic resonance apparatus, and in particular to a magnetic resonance apparatus with an arrangement for insulating sound from the examination subject.

Description of the Prior Art

Magnetic resonance is a known technique for obtaining images of the inside of the body of an object under investigation. For this purpose, a magnetic resonance apparatus has a space for receiving the object under investigation, known as an investigation space. A basic field magnet system of the apparatus generates a static magnetic field that is as homogeneous as possible, at least in a region of the investigation space. Rapidly switched gradient fields, which are generated by a gradient coil system of the apparatus, are superimposed on the basic magnetic field. In this case, currents of amplitudes which reach several 100 A flow in the gradient coils, and the frequent and rapid changes in the direction of the current are subject to rates of rise and fall of several 100 kA/s. These currents are controlled on the basis of pulse sequences and, in the presence of a base magnetic field of the order of 1 T, cause oscillations or vibrations of the gradient coil system due to Lorentz forces.

These oscillations are passed on to the entire surface of the magnetic resonance apparatus over various propagation paths. Depending on the surface speed, the vibrations of the mechanical system of the various surface regions are transformed into acoustic vibrations, which ultimately cause noise that is disturbing.

A further development in the field of magnetic resonance technology for reducing the measuring times and improving imaging properties involves faster sequences. These bring about an increase in the current amplitudes and the rates of current rise and fall in the gradient coils. Without countermeasures, this leads to larger Lorentz forces and more rapid changing of the direction in which the Lorentz forces act, then to stronger vibrations and in turn to more noise. In this way, the noise reaches peak values of, for example, up to 130 dB and is consequently above the tolerance limit of patients.

In German OS 38 33 591 a magnetic resonance apparatus is disclosed wherein the hollow-cylindrical gradient coil system of which is arranged inside a cavity of a basic field magnet system without mechanical connections with the basic field magnet system. The gradient coil system is adjustably supported by a supporting framework, which is arranged outside the basic field magnetic system, so that mechanical decoupling of the two systems is achieved. This arrangement, however, does not prevent noise originating from the vibrations of the gradient coil system from being emitted into an examination volume space of the apparatus.

In United States Patent No. 4,652,824 discloses a magnetic resonance apparatus with a superconducting base field magnet system which has a vacuum enclosure. In this case, a gradient coil system of the apparatus for reducing noise development is arranged in a specially isolated manner in the vacuum enclosure. Nevertheless, vibrations of the gradient coil system can be transmitted via fastenings of the gradient coil system to the basic field magnet system to a surface of the apparatus, where they are transformed into noise.

In European Application 0 138 269 discloses a magnetic resonance apparatus with a hollow-cylindrical basic field magnet system, in the cavity of which a hollow-cylindrical gradient coil system is arranged, in the cavity of which in turn a sleeve is concentrically arranged, forming a noise-absorbing shield between the gradient coil system and an examination volume of the apparatus. In one embodiment, an intermediate space between the sleeve and the gradient coil system is designed for this purpose in such a way that it can be evacuated. Nevertheless, vibrations of the gradient coil system can be transmitted via fastenings of the gradient core system to the basic field magnet system to a surface of the apparatus, where they are transformed into noise.

In United States Patent No. 5,489,848 discloses a magnetic resonance apparatus with a hollow-cylindrical base field magnet system, in the cavity of which a substantially cylindrical device is arranged and designed in such a way that it forms a substantially hollow-cylindrical vacuum vessel toward the basic field magnetic system. A gradient coil system of the apparatus is arranged in the vacuum vessel. Nevertheless, vibrations of the gradient coil system can be transmitted via fastenings of the gradient coil system to the basic field magnet system to a surface of the apparatus, where they are transformed into noise.

In German OS 197 34 138 discloses a magnetic resonance apparatus having a gradient coil system arranged in a vacuum enclosure to reduce noise. In this case, the gradient coil system within the vacuum enclosure is supported by a number of vibration-damping fastenings arranged at intervals. Nevertheless, vibrations of the gradient coil system can be transmitted via the fastenings of the gradient coil system